

## **DETAILED ACTION**

### **Response to Amendment**

1. Applicant's amendment, filed on October 29, 2008 has been considered and entered in full.
2. Applicant's arguments and amendments with respect to the claims and specification have been considered and are persuasive; therefore all the rejections on the respective claims have been withdrawn.

### ***Examiner's Amendment***

3. An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with applicant's attorney/agent of record, Mr. Richard Tushin, Registration No. 27,297, on 12/03/2008, Examiner's amendment:

### ***In The Claims***

- (a). The following changes to the claims have been approved by the examiner and agreed upon by applicant:

(i) **Replace the subject matter of claim 1 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** "A method of imaging an object for dental purposes, comprising the steps of:

(a) projecting using a projector a striped pattern on to the object to be imaged along an angle of projection,

(b) recording the projected striped pattern as a basic image ( $R_i$ ) with a picture receiver at an angle other than the angle of projection,

(c) repeating steps (a) and (b) at a number of different positions of phase relation of the striped pattern to provide a plurality of basic images, and

(d) computing using a computer an image of said object from the plurality of basic images that are out-of-phase with each other ( $R_1, \dots, R_n$ ),

wherein in order to suppress periodic disturbances,

(d1) recording ( $n+2$ ) basic images ( $R_1, R_2, \dots, R_{n+2}$ ) of which successive basic images show a phase shift,

(d2) forming first, second and third groups of basic images ( $R_1, R_2, \dots, R_n$ ;  $R_2, R_3, \dots, R_{n+1}$ ;  $R_3, R_4, \dots, R_{n+2}$ ),

(d3) computing using a computer a first phase related image ( $P_1$ ) from the first group of basic images ( $R_1, R_2, \dots, R_n$ ), a second phase related image ( $P_2$ ) from the second group of basic images ( $R_2, R_3, \dots, R_{n+1}$ ), and a third phase related image ( $P_3$ ) from the third group of basic images ( $R_3, R_4, \dots, R_{n+2}$ ),

(d4) averaging using a computer the first phase related image ( $P_1$ ) and the third phase related image ( $P_3$ ) in order to obtain an intermediate image ( $P_z$ ), and averaging the second phase related image ( $P_2$ ) and the intermediate image ( $P_z$ ) in order to obtain a phase related image ( $P$ ) having a reduced amount of noise,  $n$  being an integer at least equal to 3, and

(d5) computing using a computer an image of the object to be imaged from the phase related image ( $P$ ) having a reduced amount of noise.

(ii) **Replace the subject matter of claim 14 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** "A device for imaging an object for dental purposes, comprising:

projecting means for projecting a striped pattern on to the object to be imaged,

a camera for recording the projected striped pattern in the form of basic images ( $R_1, \dots, R_m$ ),

means for computing an image of the object to be imaged from a number of the basic images ( $R_1, \dots, R_m$ ) that are out-of-phase with each other with formation of three groups of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_n+1; R_3, \dots, R_n+2$ ),

means for averaging two groups of basic images, and

means for averaging the averaged image with a third group of images so as to obtain a phase related image having a reduced amount of noise.

(iii) Replace the subject matter of claim 15 as presented in the amendment filed on 10/29/2008 with:

**Examiner's amendment:** A method of imaging an object for dental purposes, comprising the steps of:

- (a) projecting using a projector a striped pattern on to the object to be imaged,
- (b) recording the projected striped pattern as a basic image ( $R_i$ ) with a picture receiver at an angle other than the angle of projection,
- (c) repeating steps (a) and (b) at a number of different positions of the phase relation of the striped pattern,
  - (c1) wherein the basic images ( $R_1, \dots, R_m$ ) are recorded by an interlacing method so that the two fields are out of phase with each other, and
  - (d) computing using a computer an image of said object from the plurality of basic camera images that are out-of-phase with each other ( $R_1, \dots, R_m$ ),  
wherein in order to suppress periodic disturbances, i.e., noise, in step (d),
    - (d0) wherein a phase related image ( $P_1, P_2$ ) is computed using a computer from each of the fields of a basic image ( $R_1, \dots, R_m$ ) and the two phase related images ( $P_1, P_2$ ) are averaged prior to further processing in such a manner that a phase related image ( $P$ ) having a reduced amount of high-frequency noise is formed,
    - (d1) forming from the basic camera ( $R_1, \dots, R_m$ ) images at least two groups of basic images ( $R_1, R_2, \dots, R_n; R_{n+1}, R_{n+2}, \dots, R_{n+1}$ ),

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(d2) computing using a computer a phase related image ( $P_1$ ) of the object to be imaged from each group of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_n+1$ )

(d3) averaging the computed phase related images ( $P_1, P_2$ ) such that a phase related image ( $P$ ) having a reduced amount of noise is formed, and

(d4) computing using a computer an image of the object to be imaged from the phase related image ( $P$ ) obtained in step (d3) having a reduced amount of noise.

(iv) **Replace the subject matter of claim 17 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** The method as defined in claim 15, wherein the basic images ( $R_1, \dots, R_m$ ) are each recorded with a constant shift of the phase relation of the lattice.

(v) **Replace the subject matter of claim 18 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** The method as defined in claim 15, including  
recording (n+1) basic images ( $R_1, R_2, \dots, R_n+1$ ) successive basic images showing a phase shift,

forming two groups of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_n+1$ ),

computing using a computer a first phase related image ( $P_1$ ) from the first group of basic images ( $R_1, R_2, \dots, R_n$ ) and computing using a computer a second phase related image ( $P_2$ ) from the second group of basic images ( $R_2, R_3, \dots, R_n+1$ ), and

averaging the first phase related image ( $P_1$ ) and the second phase related image ( $P_2$ ) in order to obtain a phase related image ( $P$ ) having a reduced amount of noise,  $n$  being an integer at least equal to 3.

(vi) **Replace the subject matter of claim 19 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** The method as defined in claim 15, including

recording  $(n+2)$  basic images ( $R_1, R_2, \dots, R_{n+2}$ ) of which successive basic images show a phase shift,

forming three groups of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_{n+1}; R_3, R_4, \dots, R_{n+2}$ ),

computing using a computer a first phase related image ( $P_1$ ) from the first group of basic images ( $R_1, R_2, \dots, R_n$ ), computing using a computer a second phase related image ( $P_2$ ) from the second group of basic images ( $R_2, R_3, \dots, R_{n+1}$ ), and computing using a computer a third phase related image ( $P_3$ ) from the third group of basic images ( $R_3, R_4, \dots, R_{n+2}$ ), and

averaging the first phase related image ( $P_1$ ) and the third phase related image ( $P_3$ ) in order to obtain an intermediate image ( $P_2$ ), and averaging the second phase related image ( $P_2$ ) and the intermediate image ( $P_2$ ) in order to obtain a phase related image ( $P$ ) having a reduced amount of noise,  $n$  being an integer at least equal to 3.

(vii) **Replace the subject matter of claim 26 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** A device for imaging an object for dental purposes, comprising:

projecting means for projecting a striped pattern on to the object to be imaged,

a camera for recording the projected striped pattern in the form of basic images ( $R_1, \dots, R_n$ ),

means for computing an image of the object to be imaged from a number of the basic images ( $R_1, \dots, R_n$ ) that are out-of-phase with each other with formation of at least two groups of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_n+1$ ), and

means for recording the basic images by an interlacing method so as to obtain a phase related image having a reduced amount of noise.

(viii) **Replace the subject matter of claim 27 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** A method of imaging an object for dental purposes, comprising the steps of:

- (a) projecting using a projector a striped pattern on to the object to be imaged,
  - (b) recording the projected striped pattern as a basic image ( $R_i$ ) with a picture receiver at an angle other than the angle of projection,
- steps (a) and (b) being carried out at a number of different positions of the phase relation of the striped pattern to provide a plurality of basic images, and
- (c) computing using a computer an image of said object from the plurality of basic images that are out-of-phase with each other ( $R_1, \dots, R_n$ ),

wherein in order to suppress periodic noise disturbances in step (c),

(c1) forming from the basic camera ( $R_1, \dots, R_n$ ) images at least two groups of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_n+1$ ),

(c2) computing using a computer a contrast image ( $P_i$ ) of the object to be imaged from each group of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_n+1$ )

(c3) averaging the computed contrast images ( $P_1, P_2$ ) such that a contrast image ( $P$ ) having a reduced amount of noise is formed, and

(c4) computing using a computer an image of the object to be imaged from the contrast image ( $P$ ) having a reduced amount of noise.

(ix) **Replace the subject matter of claim 30 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** The method as defined in claim 27, wherein

recording ( $n+1$ ) basic images ( $R_1, R_2, \dots, R_n+1$ ) successive basic images showing a phase shift,

forming two groups of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_n+1$ ),

computing using a computer a first contrast image ( $P_1$ ) from the first group of basic images ( $R_1, R_2, \dots, R_n$ ) and computing using a computer a second contrast image ( $P_2$ ) from the second group of basic images ( $R_2, R_3, \dots, R_n+1$ ), and

averaging the first contrast image ( $P_1$ ) and the second contrast image ( $P_2$ ) in order to



obtain a contrast image (P) having a reduced amount of noise, n being an integer at least equal to 3.

(x) **Replace the subject matter of claim 31 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** The method as defined in claim 27, including

recording (n+2) basic images ( $R_1, R_2, \dots, R_{n+2}$ ) of which successive basic images show a phase shift,

forming three groups of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_{n+1}; R_3, R_4, \dots, R_{n+2}$ ),

computing using a computer a first contrast image ( $P_1$ ) from the first group of basic images ( $R_1, R_2, \dots, R_n$ ), computing using a computer a second contrast image ( $P_2$ ) from the second group of basic images ( $R_2, R_3, \dots, R_{n+1}$ ), and computing using a computer a third contrast image ( $P_3$ ) from the third group of basic images ( $R_3, R_4, \dots, R_{n+2}$ ), and

averaging the first contrast image ( $P_1$ ) and the third contrast image ( $P_3$ ) in order to obtain an intermediate image ( $P_z$ ), and averaging the second contrast image ( $P_2$ ) and the intermediate image ( $P_z$ ) in order to obtain a contrast image (P) having a reduced amount of noise, n being an integer at least equal to 3.

(xi) **Replace the subject matter of claim 35 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** The method as defined in claim 33, wherein a contrast image ( $P_1, P_2$ ) is computed using a computer from each of the fields of a basic image ( $R_1, \dots, R_m$ ) and the two contrast images ( $P_1, P_2$ ) are averaged prior to further processing in such a manner that a contrast image ( $P$ ) having a reduced amount of high-frequency noise is formed.

(xii) **Replace the subject matter of claim 39 as presented in the amendment filed on 10/29/2008 with:**

**Examiner's amendment:** A device for imaging an object for dental purposes, comprising

projecting means for projecting a striped pattern on to the object to be imaged,

a camera for recording the projected striped pattern in the form of basic images ( $R_1, \dots, R_m$ ),

means for computing an image of the object to be imaged from a number of the basic images ( $R_1, \dots, R_m$ ) that are out-of-phase with each other with formation of at least two groups of basic images ( $R_1, R_2, \dots, R_n; R_2, R_3, \dots, R_{n+1}$ ), and

means for computing a contrast image from the at least two groups of basic images so as to obtain a phase shifted image having a reduced amount of noise.

***Allowable Subject Matter***

**Reasons of Allowance:**

4. Claims 1-3 and 6-39 (renumbered as 1-37) are allowed.

The following is an examiner's statement of reasons of allowance:

The closest prior art (Huang et al., 1998, "Color-encoded fringe projection and phase shifting for 3-D surface contouring") does not teach the steps of suppressing periodic disturbances such as steps (d1-d5) in claim 1, steps (d1- d4) in claim 15 and steps (c1-c4) in combination with other limitations, and further does not teach "computing an image of the object to be imaged from a number of basic images ( $R_1, \dots, R_m$ ) that are out of phase with each other with formation of at least two groups of basic images ( $R_1, R_2, \dots, R_n; R_2, \dots, R_{n+1}$ ) as recited in claims 14, 26 and 39 in combination with other limitations. Therefore claims 1, 14, 15, 26, 27 and 39 are allowed. All other claims depending on claims 1, 14, 15, 26, 27 and 39 are allowable at least by dependency on claims 1, 14, 15, 26, 27 and 39.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Manav Seth whose telephone number is (571) 272-7456. The examiner can normally be reached on Monday to Friday from 8:30 am to 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matt Bella, can be reached on (571) 272-7778. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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